POLYIMIDE/FLUOROTHERMOPLAST

INSULATED WIRES AND CABLES,

LOW FREQUENCY, 600V, -200 TO +200 °C,

BASED ON TYPE SPM

ESCC Detail Specification No. 3901/018

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space components
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Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
'A'	Apr. '94	P1. Cover Page P2. DCN P20. Para. 4.8.8	: : : Values of cut-through loads amended	None None 221146

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1. GENERAL

1.1 SCOPE

This specification details the ratings, physical and electrical characteristics, test and inspection data for Polyimide/Fluorothermoplast Insulated Wires and Cables, Low Frequency, 600V, -200 to +200 °C, based on Type SPM.

It shall be read in conjunction with ESA/SCC Generic Specification No. 3901, the requirements of which are supplemented herein.

1.2 TYPE VARIANTS

Variants of the basic types of wires and cables specified herein, which are also covered by this specification, are listed in Table 1(a).

1.3 MAXIMUM RATINGS

The maximum ratings, applicable to the finished wires and cables specified herein, which shall not be exceeded at any time during use or storage in controlled space environment, are scheduled in Table 1(b).

1.4 PARAMETER DERATING INFORMATION

The derating information applicable to the finished wires and cables specified herein is as follows:

- The maximum current for each wire used in a bundle shall be:-

$$I_{Bmax} = I_{max} \times \frac{29-n}{28} \quad (\text{for } 1 \leq n \leq 15)$$

$$I_{Bmax} = \frac{I_{max}}{2} \quad (\text{for } n > 15)$$

where n = number of wires in the bundle;

- The temperature derating information is shown in Figure 1 with maximum current I_{max} for a single wire.
- The derating factors contained herein indicate maximum stress values and do not preclude further derating.

1.5 PHYSICAL CHARACTERISTICS

The physical characteristics of the wires and cables specified herein are shown in Figure 2 and Table 1(a).

1.6 FUNCTIONAL DIAGRAM

Not applicable.

TABLE 1(a) - TYPE VARIANTS

VARIANT No.	SHIELDED		No. OF CORES	WIRE SIZE AWG	STRANDING No. OF STRANDS x DIAMETER (mm)	CONDUCTOR CHARACTERISTICS			SHIELD STRAND ⊖ (mm)	CORE MAX ⊖ (mm)	FINISHED WIRE OR CABLE CHARACTERISTICS		
	YES	NO				MAX ⊖ (mm)	NOM SECT. (mm²)	MAX OHMIC RESISTANCE (Ω/km)			MAX ⊖ (mm)	NOM WEIGHT (kg/km)	MAX WEIGHT (kg/km)
01		x	1	32	7x0.080	0.25	0.034	636			0.75	0.95	1.05
02		x	1	30	7x0.102	0.32	0.057	375			0.82	1.25	1.35
03		x	1	28	7x0.126	0.39	0.089	239			0.90	1.65	1.81
04		x	1	26	7x0.160	0.49	0.140	150			1.03	2.44	2.68
05		x	1	24	19x0.126	0.65	0.240	88.9			1.18	3.44	3.78
06		x	1	22	19x0.160	0.82	0.380	50.0			1.35	4.97	5.47
07		x	1	20	19x0.202	1.03	0.610	30.8			1.58	7.43	8.17
08		x	1	16	19x0.288	1.45	1.230	15.3			2.12	14.4	15.8
09		x	1	12	37x0.320	2.26	2.880	6.5			2.97	32.4	35.6
10		x	2	32	7x0.080	0.25	0.034	649		0.75	1.50	2.09	2.26
11		x	2	30	7x0.102	0.32	0.057	383		0.82	1.64	2.75	2.96
12		x	2	28	7x0.126	0.39	0.089	244		0.90	1.80	3.60	3.87
13		x	2	26	7x0.160	0.49	0.140	152		1.03	2.05	5.09	5.52
14		x	2	24	19x0.126	0.65	0.240	90.7		1.18	2.36	7.46	8.09
15		x	2	22	19x0.160	0.82	0.380	51.0		1.35	2.70	10.9	11.7
16		x	2	20	19x0.202	1.03	0.610	31.4		1.58	3.16	16.3	17.5
17		x	2	16	19x0.288	1.45	1.230	15.6		2.12	4.24	31.7	33.8
18		x	2	12	37x0.320	2.26	2.880	6.6		2.97	5.94	71.5	76.2
19		x	3	26	7x0.160	0.49	0.140	154		1.03	2.21	7.58	8.29
20		x	3	24	19x0.126	0.65	0.240	91.6		1.18	2.54	11.2	12.1
21		x	3	22	19x0.160	0.82	0.380	51.5		1.35	2.90	16.3	17.6
22		x	3	20	19x0.202	1.03	0.610	31.7		1.58	3.40	24.4	26.2
23		x	3	16	19x0.288	1.45	1.230	15.8		2.12	4.56	47.5	50.7
24		x	3	12	37x0.320	2.26	2.880	6.7		2.97	6.39	107	114

TABLE 1(a) - TYPE VARIANTS

VARIANT No.	SHIELDED		No. OF CORES	WIRE SIZE AWG	STRANDING No. OF STRANDS x DIAMETER (mm)	CONDUCTOR CHARACTERISTICS			SHIELD STRAND ⊖ (mm)	CORE MAX ⊖ (mm)	FINISHED WIRE OR CABLE CHARACTERISTICS		
	YES	NO				MAX ⊖ (mm)	NOM SECT. (mm^2)	MAX OHMIC RESISTANCE (Ω/km)			MAX ⊖ (mm)	NOM WEIGHT (kg/km)	MAX WEIGHT (kg/km)
25		x	4	26	7x0.160	0.49	0.140	154		1.03	2.47	10.1	11.0
26		x	4	24	19x0.126	0.65	0.240	91.6		1.18	2.83	14.9	16.2
27		x	4	22	19x0.160	0.82	0.380	51.5		1.35	3.24	21.7	23.4
28		x	4	20	19x0.202	1.03	0.610	31.7		1.58	3.79	32.6	35.0
29		x	4	16	19x0.288	1.45	1.230	15.8		2.12	5.09	63.4	67.6
30		x	4	12	37x0.320	2.26	2.880	6.7		2.97	7.13	143	153
31		x	5	26	7x0.160	0.49	0.140	156		1.03	2.78	13.0	14.2
32		x	5	24	19x0.126	0.65	0.240	92.5		1.18	3.19	19.1	20.7
33		x	5	22	19x0.160	0.82	0.380	52.0		1.35	3.65	27.7	29.9
34		x	5	20	19x0.202	1.03	0.610	32.0		1.58	4.27	41.5	44.5
35		x	7	26	7x0.160	0.49	0.140	156		1.03	3.08	17.7	19.4
36		x	7	24	19x0.126	0.65	0.240	92.5		1.18	3.54	26.2	28.3
37		x	7	22	19x0.160	0.82	0.380	52.0		1.35	4.05	38.0	39.1
38		x	7	20	19x0.202	1.03	0.610	32.0		1.58	4.74	57.0	61.3
39	x		1	32	7x0.080	0.25	0.034	636	0.064	0.75	1.37	4.16	4.40
40	x		1	30	7x0.102	0.32	0.057	375	0.064	0.82	1.44	5.05	5.33
41	x		1	28	7x0.126	0.39	0.089	239	0.064	0.90	1.60	6.17	6.52
42	x		1	26	7x0.160	0.49	0.140	150	0.079	1.03	1.71	7.04	8.25
43	x		1	24	19x0.126	0.65	0.240	88.9	0.079	1.18	1.86	9.04	9.62
44	x		1	22	19x0.160	0.82	0.380	50.0	0.079	1.35	2.04	11.6	12.3
45	x		1	20	19x0.202	1.03	0.610	30.8	0.079	1.58	2.27	14.4	15.3
46	x		1	16	19x0.288	1.45	1.230	15.3	0.079	2.12	2.83	24.4	25.8
47	x		1	12	37x0.320	2.26	2.880	6.5	0.079	2.97	3.69	45.6	48.5

TABLE 1(a) - TYPE VARIANTS

VARIANT No.	SHIELDED		No. OF CORES	WIRE SIZE AWG	STRANDING No. OF STRANDS x DIAMETER (mm)	CONDUCTOR CHARACTERISTICS			SHIELD STRAND ⊖ (mm)	CORE MAX ⊖ (mm)	FINISHED WIRE OR CABLE CHARACTERISTICS		
	YES	NO				MAX ⊖ (mm)	NOM SECT. (mm²)	MAX OHMIC RESISTANCE (Ω/km)			MAX ⊖ (mm)	NOM WEIGHT (kg/km)	MAX WEIGHT (kg/km)
48	x		2	32	7x0.080	0.25	0.034	649	0.079	0.75	2.20	8.82	9.31
49	x		2	30	7x0.102	0.32	0.057	383	0.079	0.82	2.35	10.6	11.0
50	x		2	28	7x0.126	0.39	0.089	244	0.079	0.90	2.51	11.5	12.2
51	x		2	26	7x0.160	0.49	0.140	152	0.079	1.03	2.74	14.5	15.4
52	x		2	24	19x0.126	0.65	0.240	90.7	0.079	1.18	3.06	16.8	18.4
53	x		2	22	19x0.160	0.82	0.380	51.0	0.079	1.35	3.41	22.4	24.2
54	x		2	20	19x0.202	1.03	0.610	31.4	0.079	1.58	3.87	29.6	30.5
55	x		2	16	19x0.288	1.45	1.230	15.6	0.079	2.12	5.21	32.3	55.4
56	x		2	12	37x0.320	2.26	2.880	6.6	0.102	2.97	7.03	104	111
57	x		3	32	7x0.080	0.25	0.034	652	0.079	0.75	2.32	10.0	10.6
58	x		3	30	7x0.102	0.32	0.057	385	0.079	0.82	2.48	12.0	12.7
59	x		3	28	7x0.126	0.39	0.089	245	0.079	0.90	2.66	13.5	14.3
60	x		3	26	7x0.160	0.49	0.140	152	0.079	1.03	2.90	17.3	18.5
61	x		3	24	19x0.126	0.65	0.240	90.7	0.079	1.18	3.23	22.9	24.5
62	x		3	22	19x0.160	0.82	0.380	51.0	0.079	1.35	3.62	28.4	30.3
63	x		3	20	19x0.202	1.03	0.610	31.4	0.079	1.58	4.11	38.9	41.4
64	x		3	16	19x0.288	1.45	1.230	15.6	0.102	2.12	5.53	68.7	73.0
65	x		3	12	37x0.320	2.26	2.880	6.6	0.102	2.97	7.49	141	151

TABLE 1(a) - TYPE VARIANTS

VARIANT No.	SHIELDED		No. OF CORES	WIRE SIZE AWG	STRANDING No. OF STRANDS x DIAMETER (mm)	CONDUCTOR CHARACTERISTICS			SHIELD STRAND ⊖ (mm)	CORE MAX ⊖ (mm)	FINISHED WIRE OR CABLE CHARACTERISTICS		
	YES	NO				MAX ⊖ (mm)	NOM SECT. (mm²)	MAX OHMIC RESISTANCE (Ω/km)			MAX ⊖ (mm)	NOM WEIGHT (kg/km)	MAX WEIGHT (kg/km)
66	x		4	32	7x0.080	0.25	0.034	655	0.079	0.75	2.59	12.2	12.9
67	x		4	30	7x0.102	0.32	0.057	386	0.079	0.82	2.77	15.0	15.9
68	x		4	28	7x0.126	0.39	0.089	246	0.079	0.90	2.98	16.9	18.0
69	x		4	26	7x0.160	0.49	0.140	154	0.079	1.03	3.27	21.9	23.5
70	x		4	24	19x0.126	0.65	0.240	91.6	0.079	1.18	3.66	27.1	29.0
71	x		4	22	19x0.160	0.82	0.380	51.5	0.079	1.35	4.10	36.2	38.6
72	x		4	20	19x0.202	1.03	0.610	31.7	0.079	1.58	4.68	49.5	52.7
73	x		4	16	19x0.288	1.45	1.230	15.8	0.102	2.12	6.39	94.7	101.0
74	x		4	12	37x0.320	2.26	2.880	6.7	0.102	2.97	8.65	179	191
75	x		5	32	7x0.080	0.25	0.034	661	0.079	0.75	2.74	14.9	15.6
76	x		5	30	7x0.102	0.32	0.057	390	0.079	0.82	2.95	16.8	17.8
77	x		5	28	7x0.126	0.39	0.089	249	0.079	0.90	3.16	19.2	20.4
78	x		5	26	7x0.160	0.49	0.140	156	0.079	1.03	3.47	25.1	26.9
79	x		5	24	19x0.126	0.65	0.240	92.5	0.079	1.18	3.89	31.5	33.8
80	x		5	22	19x0.160	0.82	0.380	52.0	0.079	1.35	4.38	42.5	45.4
81	x		5	20	19x0.202	1.03	0.610	32.0	0.079	1.58	5.00	58.7	62.7
82	x		7	32	7x0.080	0.25	0.034	661	0.079	0.75	2.98	17.0	18.1
83	x		7	30	7x0.102	0.32	0.057	390	0.079	0.82	3.19	19.6	20.8
84	x		7	28	7x0.126	0.39	0.089	249	0.079	0.90	3.44	24.6	26.1
85	x		7	26	7x0.160	0.49	0.140	156	0.079	1.03	3.78	30.2	32.4
86	x		7	24	19x0.126	0.65	0.240	92.5	0.079	1.18	4.25	40.8	43.7
87	x		7	22	19x0.160	0.82	0.380	52.0	0.079	1.35	4.79	55.0	58.9
88	x		7	20	19x0.202	1.03	0.610	32.0	0.102	1.58	5.79	84.1	89.7

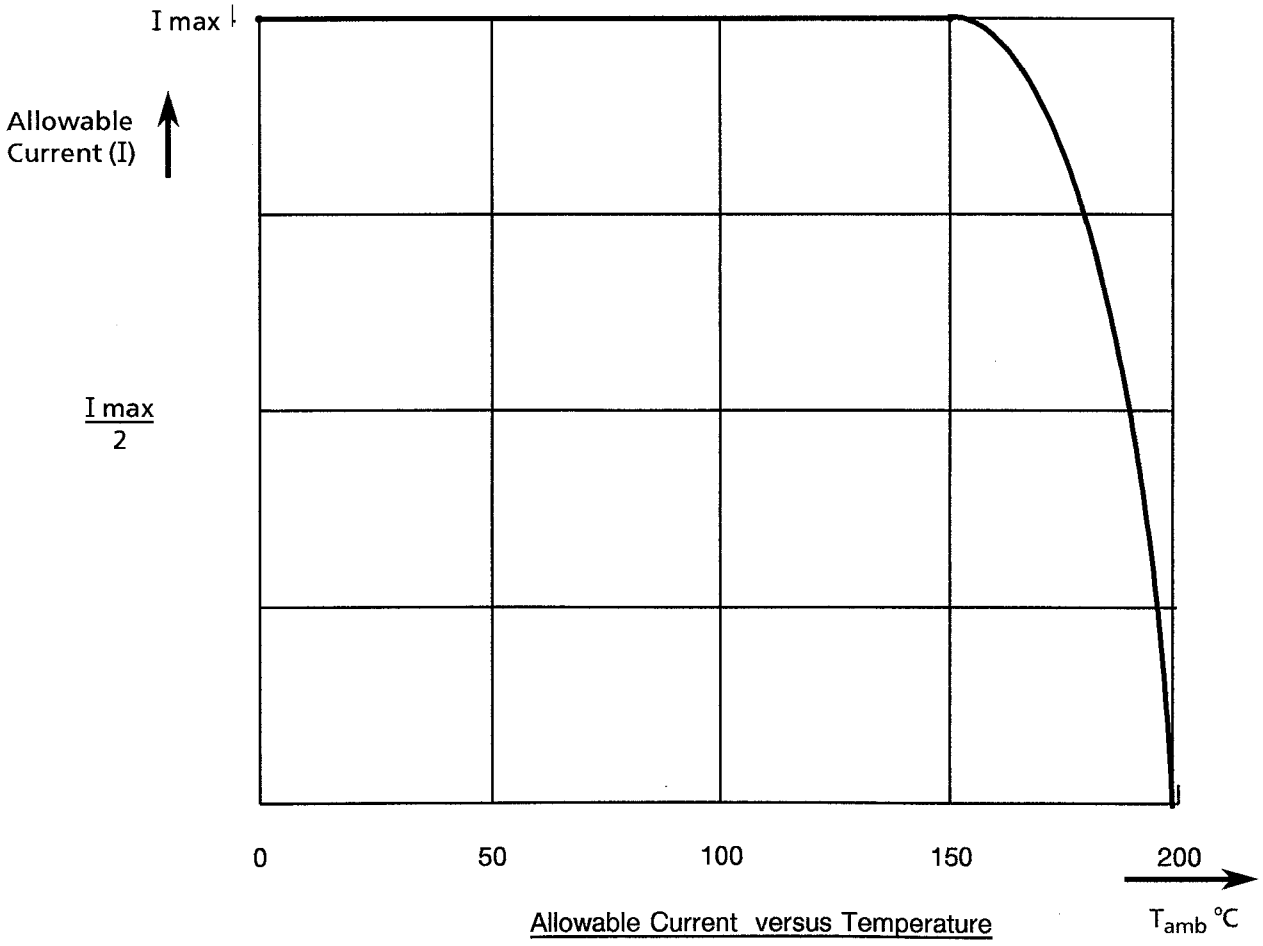
TABLE 1(b) - MAXIMUM RATINGS

NO	CHARACTERISTICS	SYMBOL	MAXIMUM RATING	UNIT	REMARKS
1	Voltage	V_P	600	Vrms	max.
2	Maximum Current (Note 1)	I_{max}	1.0 1.3 1.5 2.5 3.5 5.0 7.5 13 23	A	For AWG 32 30 28 26 24 22 20 16 12
3	Operating Temperature Range	T_{amb}	-200 to +200	°C	
4	Storage Temperature Range	T_{stg}	-200 to +200	°C	

NOTES

1. The above specified current will generate a temperature rise of approximately 50°C above ambient temperature in a vacuum environment. Precautions shall be taken to prevent the total temperature of the wire (ambient plus rise) exceeding the continuous operating temperature of the wire.

FIGURE 1 - PARAMETER DERATING INFORMATION



Allowable Current versus Temperature

FIGURE 2 - PHYSICAL CHARACTERISTICS

Dimensions are given in Table 1(a)

FIGURE 2(a) - FINISHED WIRES

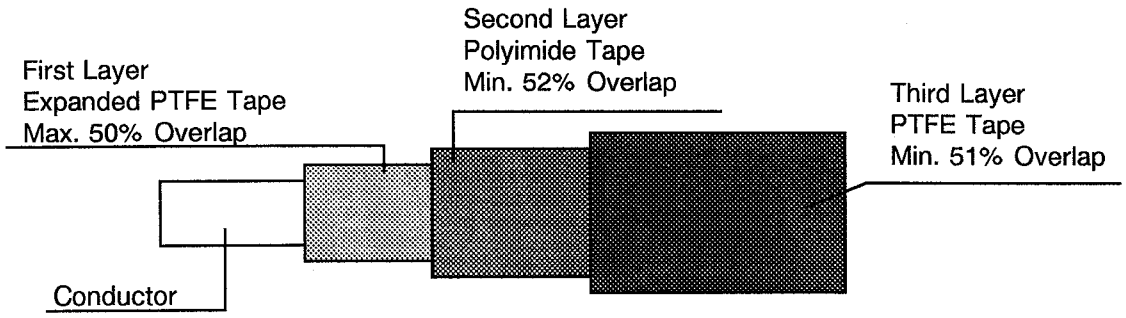
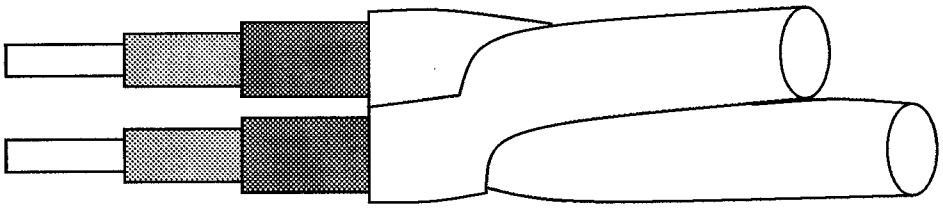


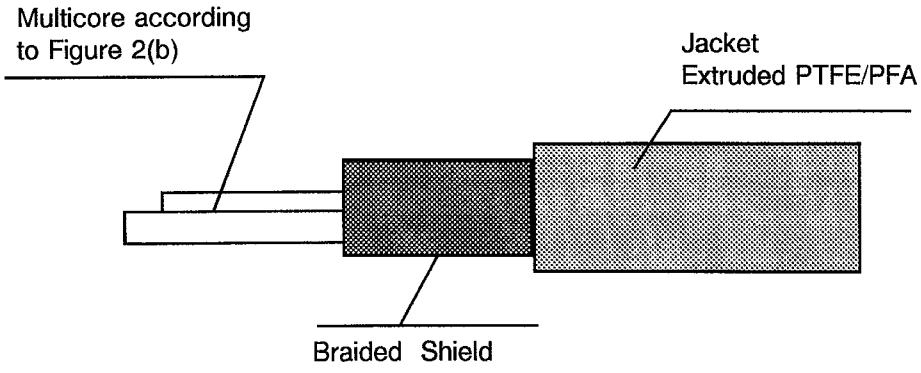
FIGURE 2(b) - MULTICORE CABLE



NOTES

1. Finished wire according to Figure 2(a).

FIGURE 2(c) - SHIELDED AND JACKETED CABLES



2. APPLICABLE DOCUMENTS

The following documents form part of this specification and shall be read in conjunction with it:

- ESA/SCC Generic Specification No. 3901, Wires and Cables, Electrical, 600V, Low Frequency.
- MIL-STD-104, Limits for Electrical Insulation Colours.

3. TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS

For the purpose of this specification, the terms, definitions, abbreviations, symbols and units specified in ESA/SCC Basic Specification No. 21300 and ESA/SCC Generic Specification No. 3901 shall apply.

4. REQUIREMENTS

4.1 GENERAL

The complete requirements for procurement of the finished wires and cables specified herein are stated in this specification and ESA/SCC Generic Specification No. 3901. Deviations from the Generic Specification, applicable to this specification only, are listed in Para 4.2.

Deviations from the applicable Generic Specification and this Detail Specification, formally agreed with specific Manufacturers on the basis that the alternative requirements are equivalent to the ESA/SCC requirements and do not affect the components' reliability, are listed in the Appendices attached to this specification.

4.2 DEVIATIONS FROM GENERIC SPECIFICATION

4.2.1 Deviations from Special In-process Controls

None.

4.2.2 Deviations from Final Production Tests (Chart II)

None.

4.2.3 Deviations from Burn-in Tests (Chart III)

Not applicable.

4.2.4 Deviations from Qualification Tests (Chart IV)

None.

4.2.5 Deviations from Lot Acceptance Tests (Chart V)

None.

4.3 MECHANICAL REQUIREMENTS

4.3.1 Dimension Check

The dimensions of the finished wires and cables specified herein shall be checked; they shall conform to those shown in Table 1(a), Figure 2 and Para 4.4 of this specification (see below for the list of parameters to be checked).

LIST OF PARAMETERS TO BE CHECKED

PARAMETER	TABLE 1(a)	FIGURE 2	PARA 4.4
COMPOSITION			
Number of conductors	X		
Gauge	X		
Shielding	X		
Jacket		X	
CONDUCTOR			
Nature			X
Outer diameter	X		
Number of strands	X		
Strand diameter	X		
Length of lay			X
Plating Thickness			X
INSULATION			
Composition		X	X
Thickness			X
Concentricity			X
Outer diameter	X		
Core identification			X
SHIELDING			
Number of strands	X		
Type of shielding			X
Strand diameter	X		
Nature		X	
Shield strand adhesion			X
Shielding lay			X
Shield coverage			X
JACKET			
Composition		X	X
Protective tape wraps		X	X
Thickness			X
Overlapping			X
Outer diameter	X		

4.3.2 Weight

The maximum weight of the finished wires and cables specified herein shall be as specified in Table 1(a).

4.4 MATERIALS AND FINISHES

The materials and finishes shall be as specified herein. Where a definite material is not specified, a material which will enable the wires and cables specified herein to meet the performance requirements of this specification shall be used. Acceptance or approval of any constituent material does not guarantee acceptance of the finished product.

4.4.1 Conductor

4.4.1.1 Material Characteristics

All strands used in the manufacture of the conductors shall be silver-coated, soft or annealed, oxygen-free high conductivity copper from AWG 12 to 22 inclusive and silver-coated high strength copper alloy from AWG 24 to 32 inclusive.

The silver thickness shall be 2 microns minimum.

For all soft or annealed copper conductors, any strand shall show a 10% minimum elongation.

For high-strength copper alloy conductors, the tensile characteristics shall be not less than 6% in elongation and 35kg per square mm in tensile strength.

For determination of the conductor resistance at +20°C, as mentioned in Para 9.5 of ESA/SCC Generic Specification No. 3901, the α coefficient for copper alloy is 0.0035.

4.4.1.2 Stranding

The conductors shall be constructed of concentrically laid strands to produce a smooth and uniform conductor of circular cross-section and free from any high strands or other surface irregularities.

Two subsequent layers shall be twisted in opposite directions, commonly known as "true concentric".

The length of lay of the external layer shall not be less than 8, nor more than 16, times the maximum conductor diameter specified in Table 1(a).

4.4.2 Insulation

4.4.2.1 Material

Any insulating material shall be virgin materials with only those additives that are necessary for processing.

4.4.2.2 Construction

The insulation shall have a uniform cross-section throughout the length of the cable and the conductor shall be evenly centred in the insulation.

The insulation shall consist of 1 wrapped layer of expanded, microporous polytetrafluorethylene with an overlap of 20%, 1 wrapped layer of polyimide tape (HR616) with a minimum overlap of 52% and 1 wrapped layer of polytetrafluorethylene with a minimum overlap of 52% as specified in Figure 2(a). The total minimum wall thickness shall be minimum 0.16mm for finished wires from AWG 32 to AWG 20 inclusive, and 0.21mm for AWG 16 and AWG 12.

4.4.3 Shield

4.4.3.1 Material

All strands used in the manufacture of the outer conductor shall be silver-coated, soft or annealed oxygen-free high-conductivity copper. The thickness of silver shall be 2.5 microns minimum. Any strand shall show an elongation of 10% minimum.

4.4.3.2 Construction

Shields shall be closely woven braid. The strand sizes for the shields shall be as specified in Table 1(a) of this specification.

The shield braid shall be a push-back type and it shall be applied in such a manner as to provide a coverage of not less than 90%. The coverage factor K is calculated as follows:

$K = (2F - F^2) \times 100$

$F = n\,Pd / \sin\alpha$

$\tan\alpha = 2\pi(D + 2d)\,P/C$

K = coverage (%)
n = number of strands per carrier
d = diameter of strands (mm)
α = angle of shield with cable axis (degree)
D = effective diameter of cable under shield (mm)
C = number of carriers
P = picks per mm

4.4.4 Jacket

4.4.4.1 Material Characteristics

Jacket material shall be extruded PTFE copolymer (PFA) as specified in Figure 2(c).

4.4.4.2 Construction

All shielded cables shall be provided with jackets with a minimum wall thickness of 0.14mm for all shielded and jacketed cables.

4.4.5 Construction of Multicore Cables

Multicore cables shall be constructed by twisting the required number and size of finished wires to form a uniform cable without high strands, bends or other irregularities. Finished wires of only one size shall be used for one cable. The cabling shall be with a left-hand lay and the lay length shall not be less than 12 times and not be more than 16 times the outside diameter of the unshielded unjacketed cable. The construction of shielded and jacketed cables is shown in Figure 2(c). Fillers shall not be used in the construction of multicore cables except for the 5-core cable, where the 5 wires shall be twisted around a round, uncoloured filler made of expanded polytetrafluorethylene. The diameter of the filler shall be 0.7 times the diameter of the wires used in the cable.

4.4.6 Colour Coding

4.4.6.1 Finished Wire Colour Coding

The colour of the finished wires shall be the red except when colouring is specifically required in the contract.

Colours:

- Black, brown, red, orange, yellow, green, blue, violet, grey, white, natural.

The colour of top wraps shall conform to the colour limits specified in MIL-STD-104, Class 1.

4.4.6.2 Multicore Cable Colour Coding

If the contract does not define any specific colour-coding, all individual cores in multicore cables shall be coloured according to the following scheme:

No. OF CORES IN CABLE	COLOUR OF RESPECTIVE CORES									
2	red	blue								
3	red	blue	yellow							
4	red	blue	yellow	green						
5	red	blue	yellow	green	brown					
6	red	blue	yellow	green	brown	grey				
7	red	blue	yellow	green	brown	grey	white			
8	red	blue	yellow	green	brown	grey	white	violet		
9	red	blue	yellow	green	brown	grey	white	violet	black	
10	red	blue	yellow	green	brown	grey	white	violet	black	orange

4.4.6.3 Jacket colour

The colour of jackets shall indicate the wire size (AWG) of the individual insulated wires within the cable.

Wire Size	Colour
32	Violet
30	Grey
28	Yellow
26	Black
24	Blue
22	Green
20	Red
16	Blue
12	Yellow

4.5 MARKING

4.5.1 General

The marking of all spools of finished wires and cables delivered to this specification shall be in accordance with the requirements of ESA/SCC Basic Specification No. 21700. Each spool shall be marked in respect of:-

(a) The SCC Component Number.

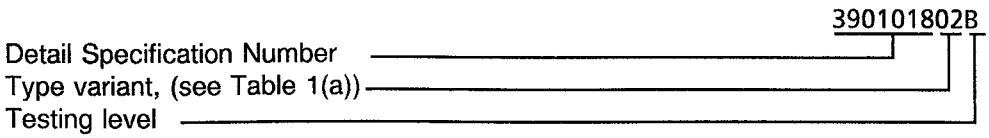
(b) Characteristics.

(c) Traceability Information.

(d) Additional Marking.

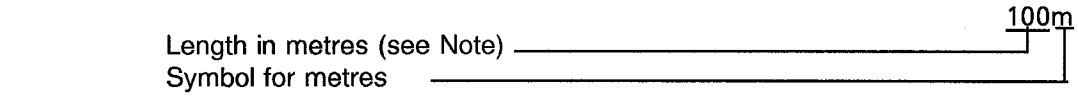
4.5.2 The SCC Component Number

Each spool shall bear the SCC Component Number which shall be constituted and marked as follows:-



4.5.3 Characteristics

The characteristics shall show the length(s) of the finished wire or cable wound on each spool and shall be marked as follows:-



NOTES

1. Whenever the length is less than 100 metres, insert a zero in the first block (example: 075 m). If more than one length of finished wire or cable is wound on a spool, the characteristics of each length shall be marked as above.

4.5.4 Traceability Information

Each spool shall be marked in respect of traceability information in accordance with the requirements of ESA/SCC Basic Specification No. 21700.

4.5.5 Additional Marking

Each spool shall bear the Manufacturer's Quality Control Inspector's stamp.

4.6 ELECTRICAL MEASUREMENTS

4.6.1 Electrical Measurements at Room Temperature

The parameters to be measured at room temperature are scheduled in Table 2. The measurements shall be performed at T_{amb} = +22 ± 3 °C.

4.6.2 Electrical Measurements at High and Low Temperatures

Not applicable.

4.6.3 Circuits for Electrical Measurements

Not applicable.

4.7 BURN-IN TESTS

Not applicable.

4.8 ENVIRONMENTAL AND ENDURANCE TESTS

4.8.1 Mechanical Properties of Conductor

As detailed in Para. 4.4.1.1 of this specification.

4.8.2 Accelerated Ageing

Ageing Temperature +230 ± 5 °C.

4.8.3 Wrap Test at Ambient Temperature

The mandrel diameters and applied loads for wrap testing of finished wires are given in Table A. The mandrel diameters and applied loads for shielded and jacketed cables are given in Table B.

TABLE A - MANDREL DIAMETERS AND LOADS FOR FINISHED WIRES

Wire Size AWG	Mandrel Diameter (mm)	Applied Weight (kg)
32	5.0	0.15
30	5.0	0.15
28	6.0	0.25
26	6.0	0.25
24	6.0	0.25
22	6.0	0.40
20	6.0	0.40
16	10	0.50
12	20	1.00

TABLE B - MANDREL DIAMETERS AND LOADS FOR SHIELDED AND JACKETED CABLES

CABLE SIZE AWG	NUMBER OF CORES	MANDREL DIAMETER (mm)	APPLIED WEIGHT (kg)
32	1	5.0	0.15
30	1	8.0	0.15
28	1	8.0	0.25
26	1	10	0.25
24	1	12	0.25
22	1	12	0.50
20	1	12	0.50
16	1	20	1.00
12	1	20	1.00
32	2	10	0.25
30	2	12	0.25
28	2	12	0.50
26	2	15	0.50
24	2	15	0.50
22	2	20	0.80
20	2	20	0.80
16	2	25	1.00
12	2	30	1.00
32	3	12	0.25
30	3	12	0.25
28	3	12	0.50
26	3	15	0.75
24	3	15	0.75
22	3	20	1.20
20	3	20	1.20
16	3	30	1.50
12	3	40	1.50

TABLE B - MANDREL DIAMETERS AND LOADS FOR SHIELDED AND JACKETED CABLES (CONTINUED)

CABLE SIZE AWG	NUMBER OF CORES	MANDREL DIAMETER (mm)	APPLIED WEIGHT (kg)
32	4	12	0.50
30	4	15	0.50
28	4	15	0.80
26	4	15	1.00
24	4	20	1.00
22	4	20	1.50
20	4	25	1.50
16	4	40	1.50
12	4	40	1.50
32	5	15	0.50
30	5	15	0.50
28	5	15	1.00
26	5	20	1.50
24	5	20	1.50
22	5	25	2.00
20	5	30	2.00
32	7	15	0.80
30	7	15	0.80
28	7	20	1.00
26	7	20	1.50
24	7	20	1.50
22	7	25	2.00
20	7	30	2.00

4.8.4 Voltage Test

No particular conditions are applicable.

4.8.5 Shrinkage

The shrinkage temperature shall be +200 ± 5 °C

4.8.6 Blocking

The blocking temperature shall be +230 ± 5 °C.

4.8.7 Cold Bend Test

The mandrel diameters and loads shall be as specified in Table C.

TABLE C - MANDREL DIAMETERS AND LOADS FOR FINISHED WIRES OR CORES

Wire Size AWG	Mandrel Diameter (mm)	Applied Weight (kg)
32	5.0	0.15
30	5.0	0.15
28	6.0	0.25
26	6.0	0.25
24	6.0	0.25
22	6.0	0.40
20	6.0	0.40
16	10	0.50
12	20	1.00

4.8.8 Cut-through Resistance

The mean load measured during 9 tests shall not be less than the relevant value specified below:-

Wire Size AWG Requirements	32	30	28	26	24	22	20	16	12
Cut-through Load (N)	60	60	60	60	80	130	170	190	200

4.8.9 Notch Resistance

The depth of notch shall be 0.04mm.

4.8.10 Flammability Resistance

No particular conditions are applicable.

4.8.11 Resistance to Fluids

No particular conditions are applicable.

4.8.12 Surface Resistance

No particular conditions are applicable.

4.8.13 Abrasion Resistance

The weight to be applied to the needle is specified below:-

Wire Size AWG Requirements	32	30	28	26	24	22	20	16	12
Scrape Abrasion (Load in grammes)	320	350	400	500	600	650	700	800	950

4.8.14 Soldering

No particular conditions are applicable.

4.8.15 Solderability

No particular conditions are applicable.

4.8.16 Radiation Resistance

No particular conditions are applicable.

4.8.17 Overload Resistance

No particular conditions are applicable. (See ESA/SCC Generic Specification No. 3901, Para. 9.27)

4.8.18 Outgassing in Vacuum

No particular conditions are applicable. (See ESA/SCC Generic Specification No. 3901, Para. 9.28)

4.8.19 Long-term Ageing Test

The long-term ageing temperature shall be +200°C.

4.8.20 Atomic Oxygen Resistance

The outer surface of the single insulated wires and the jackets of the cables are resistant against atomic oxygen and shall be verified according to the requirements of the Qualifying Space Agency.

4.8.21 Arc Tracking Test

The insulated wires are resistant against arc tracking; this shall be verified according to the requirements of the Qualifying Space Agency.

TABLE 2 - ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE

NO	CHARACTERISTICS	SPECIFICATION AND TEST METHOD	TEST CONDITION	LIMITS	UNIT
1	Conductor Resistance	ESA/SCC No. 3901, Section 9	Para 9.5	Table 1(a)	Ω/km
2	Spark Test	ESA/SCC No. 3901, Section 9	Para 9.6	Insulation :3 Jacket :1.5	kV
3	Voltage Test	ESA/SCC No. 3901, Section 9	Para 9.7	Para 9.7	kV
4	Insulation Resistance	ESA/SCC No. 3901, Section 9	Para 9.8	Insulation :750 Jacket : 30	MΩ.km
5	Surface Resistance	ESA/SCC No. 3901, Section 9	Para 9.22	125	MΩ.mm

APPENDIX 'A'

AGREED DEVIATIONS FOR GORE (D)

ITEMS AFFECTED	DESCRIPTION OF DEVIATIONS
Figure 2	Expanded PTFE tape shall be GORE-TEX®
Para. 4.4.2.2	Expanded PTFE tape shall be GORE-TEX®
Para. 4.4.5	Expanded PTFE tape shall be GORE-TEX®

NOTES

1. GORE-TEX® = Registered Trade Mark of Gore.